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"Stingout" Openings Glass Tanks

By JOHN W. ROMIG[1]

IT is surprising how quickly a tank loses temperature if a large opening is made in the upper structure for repairs, skimming or other reasons when a tank is at operating temperatures. The effect of a small opening or stingout hole or porous super structure causes a similar result though smaller in magnitude. There is no doubt but that the fewer openings there are in a superstructure the more efficient the thermal use of fuel.

The temperature drop when a large opening is made is due first to heat loss through radiation, second to the wasting of hot gas if a plus furnace pressure or stingout exists or if a negative furnace pressure exists the loss is due to the inrush of cold air which cools the furnace interior. A third loss might exist if the opening were in such a position that unburned gases actually flow through into the outside air. Small openings, observation holes and the like or a porous superstructure will cause losses more or less in proportion to opening areas involved. While the care of furnaces and tanks is improving the losses due to openings and their relative magnitude is shown in the example chosen.

The example taken is for a glass tank operating at 2600° F. with first a plus combustion chamber pressure of .01″ of water and secondly with a minus .01″ of water. An opening 4″ x 6″ rectangular in shape is typical and the furnace wall is assumed to be 12″ in thickness. It is assumed that there are no restrictions in the 4″ x 6″ opening and that the net area is 24 square inches. The coefficient of discharge of the opening is taken at .75.

An exact computation for the radiation loss requires complicated calculations; however an approximate and practical method is not as involved. The radiation loss is equal to the area of the opening times the radian angle product times the black body radiation factor. The area of the opening is readily found and in the example is 24 square inches. The black body radiation factor may be found in handbooks and texts such as Trinks "Industrial Furnaces." It is the radian angle product that requires a little effort. The example shows how it is obtained.

There is a vertical angle and a horizontal angle. The vertical angle is the angle whose tangent is $h/2 \div t/2$ where "h" is the height of the opening and "t" is the thickness of the wall, both in inches or the same unit. In the example the vertical angle is the angle whose tangent is $4/2 \div 12/2 = .333$ and looking in a table of tangents the angle is found to be approximately 18½°. The horizontal angle is the angle whose tangent is $l/2 \div t/2$ where "l" is the horizontal length of the opening and "t" is the thickness of the wall. In the example the horizontal angle is the angle whose tangent is $6/2 \div 12/2$ or .500 and the tangent tables shows the angle to be approximately 26½°.

The radian angle product is equal to the vertical angle divided by 180° multiplied by the horizontal angle divided by 180°. The radian angle product is $18.5/180 \times 26.5/180$ or .0152 for the example.

From the tables or handbook curves the black body radiation factor for 2600° F. is found to be 950. B.t.u. per hour per square inch radiation opening. The area of the opening cannot be used for calculation direct because of some of the radiation striking the walls of the opening and returning back to the furnace interior and from one wall of the opening to the other. With a very thin wall the area may be used direct while with a very thick wall radiation losses are not worthy of consideration unless the openings are large. The method of computation of the example gives a loss of 24. x 950. x .0152 or 350 B.t.u. per hour for a 4″ x 6″ opening through a 12″ wall.

Stingout or plus pressure loss is of much greater magnitude than that due to radiation. A plus pressure of .01″ of water pressure inside the furnace is equivalent to .052 # per square foot and the area of a 4″ x 6″ opening is 1/6 square foot. The gases passing out have a volume of 74. cubic feet per pound which is found as follows:—average waste gas weighs .08 # per cu. ft. at 60° F. so there are 12.5 cubic

[1] Corning, N. Y.

feet per pound at 60° F., connecting for 2600° F. it becomes 74. cubic feet per pound.

The volume of gas issuing is equal to the velocity times the area of the opening and the velocity = $\sqrt{.75\ 2g\ (Pi\text{-}P2)}$ x B where "g" = gravity or 32.2, "(P1-P2)" equals pressure causing flow in pounds per square foot, "B" equals the volume of waste gases per pound and .75 is the assumed orifice factor. In the example the velocity = .75. $\sqrt{2 \times 32.2 \times .052 \times 74.}$ or 11.8 feet per second. The volume passing per hour equals 1/6 x 3600. x 11.8 or 7080. cubic feet. As one cubic foot of waste gas at 600 when heated to 2600° F. has a heat content of 60 B.t.u. the apparent heat loss is 425,000. x 520/3060 or 72,000 B.t.u. per hour when the volume is corrected for standard temperature conditions.

In the case of a regenerative or recuperative tank the actual loss is the difference in heat content at the furnace temperature and the heat content leaving the checkers. At 1200° F. the waste gas has a heat content of 32,000 B.t.u. so 72,000. minus 32,000 gives a direct loss of 40,000 B.t.u. per hour.

When a negative pressure is maintained cold air is drawn into the combustion chamber through openings and cools the combustion or working chamber. An example with a 4″ x 6″ hole and a negative furnace pressure of .01″ of water shows a loss of 165,000. B.t.u. per hour. This is found as follows:—The velocity through the opening = $.75\sqrt{2 \times 32.2 \times .052 \times 13.0}$ or 5.0 ft. per second, the volume equals 1/6 x 3600 x 5.0 or 3000 cubic feet of air per hour. As 55 B.t.u. are required to heat one cubic foot of air the loss becomes 165,000 B.t.u. per hour.

While the above figures represent approximate losses for assumed conditions they show the relative importance and magnitude of losses due to openings in a superstructure. A negative pressure is undesirable and will cause greater losses than a plus pressure of equal magnitude. Radiation losses are not considered as of sufficient magnitude to warrant consideration unless openings are large.

Glass to Be Featured at Chemical Exposition

Glass, one of the most ancient materials, now advanced in its technology, and utilized in thousands of new ways, will be one of the most interesting materials at the Chemical Exposition this December. The originators and world's largest builders of glass-lined steel equipment will show a complete glass-lined steel distillation assembly. A large glass-lined reaction kettle will be in contrast to a small glass-lined dye mixer. This company's exhibit will be unique in its plan to show how and where glass-lined steel equipment can be used profitably in the three phases of chemical manufacture—laboratory, trial production, and commercial production. The point of this is that glass laboratory equipment has its counterpart for commercial work in the large glass-lined steel units. In all of this there is reflected man's fight against corrosion. In addition, the present high standards of sanitary control have increased the uses of glass-lined equipment, not only in the chemical industries, but in the food industries, in the handling of milk, and in brewing.

COOK FOREST MEETING OF THE GLASS DIVISION

American Ceramic Society, October 29-31, 1933

The summer, or fall meeting of the Glass Division was this year held at the Cook Forest Inn, on the middle reaches of the Clarion River, near the southwestern edge of the Appalachian Plateau. Since the summer meetings were originated by Francis Flint, they have been held at Cove Point, Maryland (twice); Old Point Comfort, Virginia; Woodmont, Maryland; and now at Cook Forest, Pennsylvania.

It seems to have been generally conceded that the last was the least satisfactory of these meetings; and that the fall meetings had better be discontinued unless the spirit of the earlier meetings can be recaptured.

Some considerable effort was put into the preparation of this meeting by Jack Waggoner, Francis Flint, and others; the weather was good; the forests were beginning to turn color; the tall timber was stately as ever. But the reviewer has not found anyone who was satisfied with the meeting.

The officers of the Division and some of their stalwarts went into a three day huddle over the program for next February at Cincinnati. It is evident that a great change is taking place in the character of the winter meeting, and of the profession of glass technology. Whereas good papers were hard to get and had to be sought with thimbles and care, with forks and hope, in the Cove Point days—only a few years back—now papers are becoming almost embarrassingly plentiful. Not only that, but judging by the last meeting (Pittsburgh, 1932), their general standard is greatly improving. Long may it be so, but the task of organizing the February meeting thus changes entirely in character, and a very different responsibility rests on the officers of the Division, and the organizing work proceeds apace at the summer meeting, to the detriment of the summer meeting itself.

The accommodations at Cook Forest were not so luxurious as those at Old Point Comfort, being more nearly in the Cove Point style. The food was neither plentiful nor strikingly good; but Woodmont venison, turkey, and pheasant may have spoilt the appetites of the connoiseurs. However, a prosaic meal seems out of place after the knee-deep crab shells that surrounded J. T. Littleton and Roy Blunt after their repasts at Cove Point, or the serried calcareous masses of oyster shells that loaded the tables at the same resort. And nothing is here said of all the fishes that Ross Purdy purloined at midnight, with a leaky old boat, from the fishermen's nets out in Chesapeake Bay.

We missed the goodly contingents that erstwhile the "Bureau" and "Geophysical" and Baltimore contributed to the earlier meetings; but it was good to see Hettinger around once more with his inseparable camera, and Charlie Spencer once again on the job from Cleveland. We were glad also to see Nelson Taylor of State College, and several other new faces; and we feel confident that there is enough vitality in the Division, both among its old pillars and its new supporters, to produce in 1934 a summer meeting worthy of its Cove Point ancestry.

F. W. Preston.

Dangers of Zinc Have Been Exaggerated

GLASS plants employing zinc for any purpose will doubtless be interested in an article which appeared in the August 11, 1933 issue of "Public Health Reports" under the heading "Zinc in Relation to General and Industrial Hygiene." The authors are Cecil K. Drinker, M. D. and Lawrence T. Fairhall, Ph.D. of the Department of Physiology, of Harvard School of Public Health, Boston, Mass.

Recent investigations have greatly simplified and defined the problems arising from the ingestion and inhalation of zinc and zinc compounds. It is now known that zinc is not a poison in the usual sense of the word. That is to say, pure zinc, in contrast to metals such as arsenic, lead, antimony, and cadmium, has no poisonous qualities even if taken in large amounts. Certain zinc compounds, such as zinc chloride, are highly irritating and caustic; but this action is the common property of an infinite number of chemical substances. Certain other zinc compounds, such as zinc oxide or zinc stearate, on account of their fine state of division or their tendency to flocculation, may do harm, but not on account of their zinc content. Such effects are understandable and avoidable, a far different situation from that which would exist were the zinc ion poisonous in itself, so that after absorption one might count upon a series of unfortunate effects ending with elimination, with safe storage, or with the death of the subject.

This point of view is not in accord with the reputation zinc has held, a reputation which has arisen from the fact that zinc in the majority of instances occurs in ores with such substances as lead, arsenic, antimony, and cadmium, all definitely poisonous. Thus the older literature of general and industrial hygiene contains frequent descriptions of what are listed as cases of acute or chronic zinc poisoning, in which the symptoms are attributable to contaminating metals.

Believing that it is worth while to redefine the hygienic position of zinc the authors discuss the subject under the following heads: "Zinc in Relation to the Health of the Public" and "Zinc in Relation to Industrial Hygiene".

The occurrence of zinc and zinc compounds in drinking water is discussed, also zinc and zinc compounds in food.

A summary of the hygiene position of zinc is given.

1. In 1925, a publication of the Public Health Service (Reprint no. 1029) placed a limit of five parts per million of zinc in drinking water. This limit has been applied freely to many conditions in which zinc is ingested. Since the zinc ion is not of itself poisonous, and many times five parts per million may be taken without harmful effects, it is suggested that this limit, which gives a relatively innocuous metal an undeserved reputation for toxicity, be increased or done away with altogether.

2. Foods or beverages, with the exception of simple or chlorinated drinking water, should not be stored in zinc-lined or galvanized containers. Acid drinks and foods will invariably cause solution of zinc and the formation of simple compounds of zinc which irritate the stomach and may cause vomiting.

3. A single industrial condition arises from zinc and this condition is not produced by zinc alone. This is the "zinc chill", better known as metal fume fever. The different groups of symptoms described as chronic industrial zinc poisoning, together with other complex ills which have been ascribed to zinc, may be disregarded, as they are due to contamination by other substances.

Society of Glass Technology, London Section

The opening meeting of the session of the London Section of the Society of Glass Technology was held in the Science Museum on Wednesday evening, October 4, with Colonel S. C. Halse, C.M.G., in the chair.

The meeting commenced with a welcome to Sir Henry G. Lyons, D.Sc., F.R.S., Director of the Science Museum, who was present in his official capacity for the last time at a function of the Society. His retirement was due to take place on October 10, and in his reply, Sir Henry Lyons offered the apologies of his successor, Colonel E. E. B. Mackintosh, D.S.O., for his inability to accept the invitation of the Executive Committee to attend the meeting.

As some of the members of the Society had recently returned from a visit to Italy, where they had attended the International Congress on Glass and Ceramics, the main item on the agenda consisted of descriptions of the Congress and of the subsequent visits to Italian glassworks. Mr. Edward Meigh, M.B.E., M.Sc., confined his remarks to the Congress and to the tour in general, while Mr. T. Wardley and Dr. J. H. Partridge described visits to a glass bottle works in Milan and to a glassworks in Murano respectively. The talks were greatly appreciated and the speakers were called upon to answer several questions concerning furnace design and methods of manufacture generally. Those who took part in the discussion included Messrs. Dudding, Hogan, Marchand, Marden and Orme.

Program for Session 1933-1934

November 8. Visit to Canning Town Glass Works.

December 13. Annual dinner.

January 10. Paper: "Modern Uses of Glass" by G. Lovell, Esq.

February 7. Visit to Streatham Works of United Dairies, Ltd.

March 7. Paper: "Thermometers" by A. J. Hall, Esq.

April 4. Visit to James Powell & Sons (Whitefriars) Limited.

Professor Silverman's Famous Collection of Glass

THE collection has been in the making for over thirty-one years and is comprised of specimens from all parts of the world. The countries represented include the United States, Mexico, Scotland, England, Belgium, France, Holland, Sweden, Germany, Czechoslovakia, Italy, China, Japan, Russia, Armenia, Egypt, Greece, Palestine, etc. The collection consists of thousands of specimens representing the art and technique of glass manufacture—chiefly the modern.

It is reputed to be the foremost collection of modern glass, from the standpoint of art and technique, in the world. Many of the artistic productions are the outstanding contributions of the foremost artists of the various nations. In numerous cases, examples of their art are shown which are not duplicated even as to type, in any other collection. At present, the collection is located in the Chemistry Department of the University of Pittsburgh.

We print below the paper entitled "Glass Collecting as a Hobby," which was presented by Prof. Silverman before the Division of Chemical Education of the American Chemical Society at the 82nd meeting, Buffalo in 1931.

"Collecting begins with an early impulse to possess something that appeals to the senses, particularly to the sight. The child obeys these impulses by picking up odd bits and filling his pockets. Choice and discrimination come with experience.

Collecting some particular kind of thing has become the hobby of many. Not a few have made their hobby glass collecting. My own impulse began when I worked in a glass factory twenty eight years ago. At first glass was collected for its technology, its color; then came a gradual appreciation of art, with particular attention to the technic necessary for the execution of the art. A collection has grown from its small beginning to what is now reputed to be the most representative collection of modern glass in existence, from the standpoint of both art and technology.

In confining myself to the modern in art I followed a profound impression which was made by the late Andrew Carnegie, who, on endowing the Carnegie Institute of Pittsburgh, stipulated that his money should be spent only for the best of modern paintings, which would in time become the best of the older art. By modern art I mean the products of the past one hundred years, for the United States Treasury Department classes as antiques, objects which are more than one hundred years old. Most of the modern glass in my own collection has been made within the past twenty-five years, and a little goes back fifty years.

You will naturally be interested in knowing how I have proceeded in gathering my collection, and what some of my experiences were. I shall follow an outline which includes museums, shops, factories, display rooms, antique shops, the literature, expositions, friends.

Museums play an important part in the education of the collector. In my visits to the larger American cities it has always been my practice to spend some time in the museums and art institutes of these centers. The same is true in connection with European travel. There is hardly a city whose museum does not contain some glass, and while few of these museums contain extensive or representative collections, there is usually something of particular interest in each. Were I to select the American museums which have impressed me most, I should include the Metropolitan Museum of Art in New York, which houses the richest collection of ancient glass in the world, and which has some of the most precious of modern art; the Toledo (Ohio) Museum, noted for the

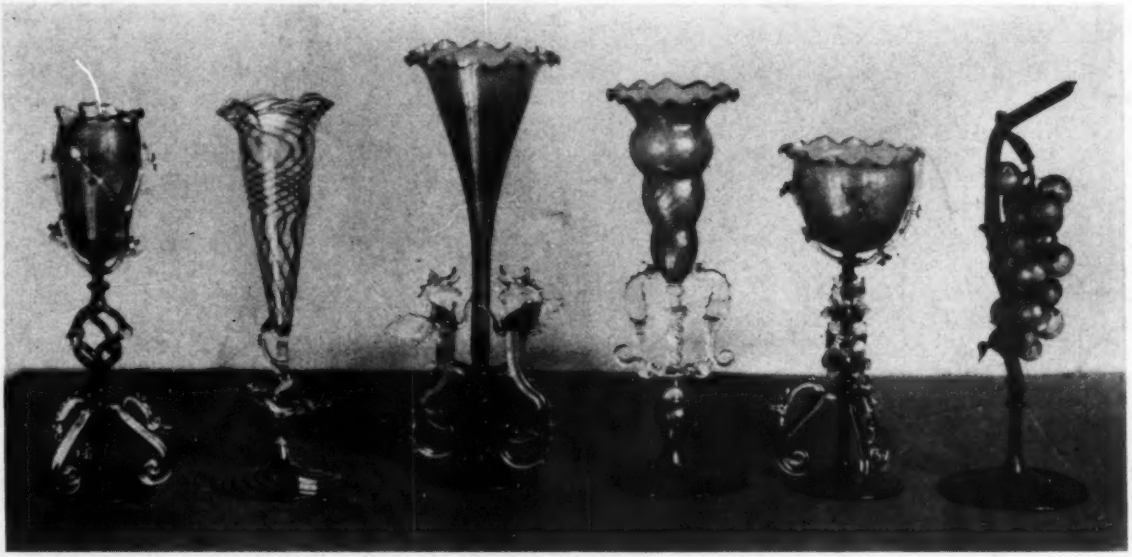
PROFESSOR SILVERMAN HOLDING THE MOST PRECIOUS PIECE IN HIS COLLECTION, A VENETIAN VASE

Edward Drummond Libbey collection of ancient glass; the Art Institute in Chicago, noted for the Rosenwald collection and for one of the most extensive collections of Chinese glass in America. In the Royal Ontario Museum in Toronto there is an interesting variety of ancient and modern glass, principally the former. Of the European Museums the one at the Hague in Holland naturally contains an unusual collection of Dutch glass. The most valuable specimens are those which have been decorated by stippling with a diamond point. In the British Museum in London is the largest and

best collection of early English goblets to be seen anywhere. This museum until May of 1930 housed the famous Portland Vase, the finest specimen of cameo glass ever produced, which was unearthed in Rome shortly after the beginning of the Christian era. In Paris the Conservatory of Arts and Measures has the most representative collection of modern glass to be found in any public museum. In the Cluny Museum we find the older glasses, and especially an unusual collection of Venetian decorations. In Berlin the Deutsches Museum and Schloss Museum contain rare exhibits, principally of the older glasses which have been presented by individual collectors; and in Jena, Germany, is the Zeiss Museum for optical glass and instruments. Munich has its world-famous Deutsches Museum which includes a section on glass, especially depicting manufacture. In Rome ancient glasses are shown in the Vatican Museum and in the Diocletian Museum. Florence has the Science Museum in which one may see the glass apparatus which was employed by Galileo and which is of the fantastic design characteristic of the Venetian glassblowers who prepared it. In Murano near Venice, is the old museum which shows the earlier Venetian products. Time is not available to discuss any of these in detail but the traveler will be well repaid in his visits to any or all of the museums mentioned.

Shops in which glass is for sale are another source of education, and here one may not only see modern products but have the opportunity of purchasing them if they appeal. The real collector suffers many a heartache in a museum, but if his purse can afford it he can purchase the object of his choice in a shop. It is hardly necessary to catalog these shops, the best of which are to be found in New York, Chicago, San Francisco, Boston, and Pittsburgh. Some of my most valuable specimens have been purchased in shops, which I usually visit together with the museums in a city.

Factories afford a real education if one can gain admission. The collector should know something about the method employed in making the object which he collects. There is a large variety of glass manufacture. Perhaps the most interesting factories are those engaged in the manufacture of art glass in the form of vases, etc. Among these is the famous Steuben Glass Works at Corning, New York; the Vineland Flint Glass Works at Vineland, New Jersey; the Val Saint Lambert factory at Liege in Belgium; Stevens and Williams in Stourbridge, England; Daum's factory at Nancy in France; Moser's in Kaarlsbad, Czecho-Slovakia; and the various factories in Murano, near Venice. The last named are particularly fascinating for the European traveler. In my own travels both here and abroad I have visited these and many other factories and have usually found that the manufacturer was willing to sell the object of my choice, outright, or direct me to some dealer or representative through whom I could purchase it. Many of my most valuable pieces have been bought in this way.



GERMAN REPRODUCTIONS OF OLD VENETIAN GLASS

Display rooms are another source of education and supply. I shall never forget the exhibit of the Swedish Arts and Crafts in Chicago, and the displays of many representatives of foreign manufacturers in New York City, whose names can be gleaned from the classified portion of the telephone directory. It is my practice to visit annually the glass show in Pittsburgh during January. Here I cover the various exhibits on some seven or eight floors, in each of two of our leading hotels. Through manufacturers' representatives at the glass show, I have again secured many of the interesting objects in my collection.

Antique and second-hand shops are another source of supply. These are interesting in the larger cities, but are sometimes more fruitful on motor tours through the villages and

(*Continued on page* 121)

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CONTENTS

"Stingout" Openings Glass Tanks 115

Glass to Be Featured at Chemical Exposition 116

Dangers of Zinc Have Been Exaggerated 117

Society of Glass Technology, London Section 117

Professor Silverman's Famous Collection of Glass 118

Editorial:

Review "The Electrical Properties of Glass" 120

Glass in the Philippines 122

Report of the American Window Glass Co. 122

Overmyer Purchases Cook Bros. 122

September Production of Plate Glass 7

Current Prices of Glass-Making Materials 124

CLASSIFIED BUYERS' GUIDE, PAGE 7

INDEX TO ADVERTISEMENTS, PAGE 8

Reference to the contents of earlier issues of THE GLASS INDUSTRY can be found in THE INDUSTRIAL ARTS INDEX in many Public and Technical Libraries.

REVIEW

"The Electrical Properties of Glass"

By J. T. Littleton and G. W. Morey. John Wiley & Sons, N. Y. Chapman & Hall, London, 1933.

Being Monograph No. III of the National Research Council —Committee on Electrical Insulation.

THIS is something new in the way of books on glass technology, and is a straw showing which way the wind is blowing. Hitherto, books on glass technology have usually been a mass of errors, but they have been intelligible. The tradition is now reversed.

No book on glass has previously appeared showing one tenth the knowledge and care that is compressed into these one hundred and eighty pages. And no book has needed one-tenth the knowledge to understand it.

The essential parts of the book begin at P. 55 and consist of four chapters, viz: Chapter II—Electrical Conductivity, Chapter III— Dielectric Constant, Chapter IV—Dielectric Loss, Chapter V—Dielectric Strength. Practically the whole of these chapters consist of a critical resume of the published literature on the subjects involved. Almost every page is closely documented with references to the original work. Now and then the authors step aside to explain the essence of the subject, but for the most part the book is a work for experts, more particularly for experts in the electrical field and not for glass technologists.

The electrical conductivity of glass becomes important in such commonplace articles as "tubes" for radio sets. The electrical circuit is here completed, not through wires, but by electronic discharge through the gas in the tube. As everyone knows, the tubes must be warmed up before the radio starts to talk. When it is warm, the glass in the stems of the "tubes" around the leading-in wires becomes warm too, and electrical conductivity rises very rapidly with rising temperature. The early tubes gave a good deal of trouble on this account, the current, when the glass got hot, being partly shorted through the glass itself. Considerable work was done on the subject, and much interesting information acquired, but very little of this is hinted in the book under review. In the broadcasting stations the big glow tubes are sunk in tanks of oil, and the oil is cooled in its turn by pipes of circulating water. This also, we believe, is in part at least, an effort to prevent electrolytic deterioration of the glass.

Glass that is definitely intended for severe electric use is usually soda-free: it helps to use potash instead: it is still better to avoid alkalis entirely and turn to the boro-silicates, especially the Pyrex types, or to fused silica. The latter part of the book is therefore concerned more particularly with glasses of these types. This of course is as it should be, but it renders somewhat superfluous a rather substantial section of the first chapter—the introductory one—on the equilibrium diagrams of the soda-lime silica triangle. We all admire these diagrams, and many of us hang them on the walls of our laboratories, but the flowers that bloom in the spring, tra-la, have nothing to do with the case.

(*Continued on page* 123)

(*Continued from page* 119)

outlying districts. Some of my American glass of the earlier part of the last half century has been acquired in this fashion. A few years ago, while the guest of Dr. Harrison E. Howe on Cape Cod, off the Massachusetts coast, I had the pleasure of visiting the small towns and their shops. Here, some unusual pieces of old Sandwich glass were acquired, and I am not referring to the ordinary pressed plates and dinner ware which most Sandwich collectors gather. There are two or three vases in my collection which possess unusual art and technic. To authenticate these, I visited the site of the old

SECTION OF CASE—EAST WALL OF PROFESSOR SILVERMAN'S OFFICE

Sandwich factory and dug into the ground for broken bits of the glasses which were made in those early days. Fortunately, I authenticated the pieces which I had purchased, by comparison with these bits of glass. In an antique shop in Edinburgh, Scotland, I found a beautifully engraved duck-head in cameo, an old English perfume bottle of the kind which the ladies of the '80's and '90's carried in their purses. The Rag-Pickers' Fair in Paris and similar street fairs in other European cities bring many treasures to light. In our American cities, there are associations for the improvement of the poor, which gather up old household effects and place them on sale. These often include good specimens.

With the procedure already outlined, the collector has acquired sufficient practical experience to begin to appreciate the literature. It is, of course, a matter of opinion whether one should begin with the literature and then start collecting, or acquire some experience and then interpret more perfectly through reading. It is my opinion that the latter order of things is better. The libraries in our larger cities are fairly well supplied with books on the history of glass, which are rather fully illustrated. These cover both American and European products. The mere fact that a specimen resembles an illustration does not prove its authenticity. Some modern manufacturers make it their business to reproduce antiques. If in doubt about the genuineness of a piece under consideration, it is well to refer it to an authority on glass in a particular country. Color and shape alone are insufficient criteria. The dimensions of a design, or the markings produced by a particular mold, will help to identify the object. These are known only to specialists of the highest order, men, for example, like Frederick W. Hunter, whose collection of early American glass is housed in the Metropolitan Museum of Art in New York.

Expositions, though available only at comparatively long intervals, are usually well provided with exhibits of modern art and technology, for it is their business to advertise such products. A few years ago at the Sesqui-Centennial Exposition in Philadelphia there was an elaborate display of the products of some European factories, especially those of Germany and Czecho-Slovakia. A few decidedly unusual specimens were added to my collection through this visit. In the fall of 1930 I had the good fortune to visit the Centennial Expositions in Liege and Antwerp, Belgium. The one at Liege included exquisite displays of Belgian and French glass. At Antwerp were shown displays from Holland and Spain. Needless to say, these expositions were a further source of supply. The exposition which is planned for Chicago in 1933 will undoubtedly include some famous exhibits of glass from all parts of the world. Many American collectors will have opportunity of visiting this exposition.

My last source of information and supply has been one of the most precious in my personal experience. I refer to friends. They have discovered unusual treasures here and abroad, some of which I hve purchased, others of which they have presented. It is important to discuss your hobbies with those of your friends who can appreciate them and who are likely to take an interest in what you are doing. They are allies to the collector and their service is often beyond appraisal.

The big question with the collector is, 'What shall I choose?' This cannot be answered in any general way. Travel, reading, study of the relative merits of things one sees, and principally experience, are the determining factors. The best of us are fooled at times, and I have had to smile to myself on occasion which I was the victim."

Glass In The Philippines

By Walter Buchler

Whilst all houses or dwellings in the early days of the Islands had but openings in the walls for windows, the natives have for centuries used a kind of clam shell found in the sea around the Philippines as glass. This they trimmed with a knife or pair of scissors and put in a window frame 4 inches square. These shell windows are still widely used for windows in wooden houses, but they are not practicable for the ordinary Nipa (palm leaf and bamboo) dwelling, as there is nothing to hold them, the frame being too weak. These shell windows let in light to a certain extent, something after the style of ground glass and are considerably cheaper than glass.

Glass was introduced with the American occupation of the Philippines, during the Spanish regime French plate and other glass was already being used for the houses of Spanish officials and rich homes, but then it was mostly for show windows. Since then French plate glass has continued to be used for store windows and window glass for buildings. The majority of the Government buildings are of concrete and are equipped with glass windows and the same applies to the homes of the well-to-do which are built of hard materials.

The largest demand is for common window glass which is imported from Belgium and is used for dwelling houses and showcases and to a lesser extent in store buildings. Plate Glass is imported from the United States and Belgium and is used chiefly for Government buildings, window shields and doors. Figured glass is extensively used for church windows—there are many churches in the Islands, the people being Catholics—also in dwelling houses. Philippinos are very fond of mirrors and even in the remotest country one will find them in most Nipa shacks. These mirrors are mostly plain and are of the cheapest kind. The richer people like to have Venetian mirrors which, here, resemble more a mitred mirror or semi-Venetian than real Venetian. Philippinos, Japanese and Chinese carpenters do the setting of windows, the Japanese being the most satisfactory and able in this kind of work. Labor is considerably cheaper than in Western countries and there is not the same breakage of window glass as one finds in the United States or in England.

Glass is imported through merchant houses in Manila who buy direct from manufacturers or exporters overseas and sell direct to hardware firms and even to carpenters direct. Salesmen are employed to obtain orders and work on a commission basis. There are many commission agents in the country, mostly Philippinos, who are really travelling salesmen, earning their living on the commission received for orders taken by them.

Report of the American Window Glass Co.

The American Window Glass Company reported through W. L. Monro, president, that although less glass was produced by the company during the year ended August 25, a profit from manufacturing, and settlement of the tax claims with the Federal Government permitted the company to report an earned surplus for the year.

President Monro is quoted as follows:

"The financial statement shows an operating loss for the year of $443,894.35, after deducting administrative, selling, development and shutdown expenses.

"Inventories, except of the cylinder glass, are carried at cost or market, whichever is lower. The inventory of cylinder glass is carried at a very low figure, in fact, much lower than will likely ever be reached when it is finally disposed of.

"By comparing the present financial statement with that of the previous year, it will be seen that after deducting losses due to prior years operations, also on the sale of inoperable properties, and the past year's losses, as a result of the tax settlement with the United States Government, the books now show a surplus of $1,893,557.96, as compared with a deficit of $696,378.07 on August 26, 1932.

"Attention is also called to the fact shown on the statement, that the entire indebtedness of the company amounts to $126,274.43, incurred on current accounts for materials and wages in process of being audited."

The company has been working on the further development of the manufacture of safety glass with Plexigum. That is the name given by the inventor to the liquid used as the binder in making this product. "Plexite" is the name under which this new product will be marketed. It is claimed to be superior to any other kind of safety glass on the market, demonstrated by every test to which such glass is subjected.

Overmyer Company Purchases Cook Bros.

To protect its source of supply for castings for use in the production of moulds, the Overmyer Mould Co., of Winchester, Ind., producer of bottle and jar moulds, has purchased the foundry of Cook Bros., also of Winchester.

Both the mould plant and the foundry will be devoted exculsively to the needs of the glass industry and will produce special moulds from special castings for particular glass factories in addition to its own production. Effort will be concentrated on the production of castings and moulds for glass factories only. The new foundry will be used to produce the best iron possible for glass factory use.

It will be recalled that the Overmyer Mould Co. recently purchased the mould business of the Lynch Corporation, of Anderson, which had been taken over on the purchase by the Lynch Corporation of the Miller Machine & Mold Works of Columbus, Ohio.

C. P. Overmyer is president of the Overmyer Mould Co.; Wm. M. Elkins is vice president and Morton Longnecker is secretary-treasurer.

(*Continued from page* 120)

This first chapter is no doubt intended to give electrical engineers, in briefest outline, an idea of the modern glass technologists views on glass. We do not think it is likely to be very successful, or that the points to stress have been any too well chosen. The pages on annealing are altogether too technical, and the old confusion between $\mu\mu$ and m^{μ} is once more injected into our politics after its ghost had been well and truly laid by Bailey & Sharp. It is certain, we think, that no electrical engineer will be able to understand the treatment given; and the glass technologist will only understand it with the aid of much extraneous information.

This seems a convenient place to interject the remark that glass technologists are exceedingly slip-shod in their descriptions of birefringence or double refraction. Strictly speaking, birefringence is the difference of two refractive indices and should be so stated. This is the petrologist's way and is used, for instance, in Dr. Insley's papers.

What is actually observed however, is a color-change in the polariscope, or the displacement of a line in a Babinet compensator, or so many turns of a screw attached to a compensating wedge. All of these are affected by the thickness of the specimen, and they amount to observations of so many wave-lengths displacement of a color or calibrating device. This is particularly suitable when working with a Babinet compensator of the type commonly used by the present reviewer, wherein the displaced part of the Babinet line is usually seen in the same field as the undisplaced line, or a hair line that marks its original position. Accordingly the observed birefringence is then conveniently expressed as (say) 1½ wave lengths per inch of light path in the specimen.

Adams & Williamson in their original work went further. A wavelength of sodium (D line) light is so many millimicrons long, as a matter of fact, 589 of them. Thus 1½ wave lengths is 785 millimicrons, and $1\frac{1}{2}\lambda$/inch is 785/2.54 =348 millimicrons/cm. With compensating wedges or instruments involving a micrometer reading, such a way of figuring is natural and was used by Adams and Williamson, by Bailey and Sharp, and others. Originally, and for many years, a millimicron was written "$\mu\mu$." The 1911 edition of Kaye and Laby for instance, states definitely (P. 75), $\mu\mu = 10^{-7}$ cm. The purists then got to work and proved that 10^{-7} cm. $= m^{\mu}$, and if so, then $\mu\mu = 10^{-10}$ cm.

Bailey and Sharp, with a picturesque protest, agreed to the new ruling, and Adams himself in his latest treatise on annealing (J. Franklin Institute, July, 1933, Vol. 216, p. 51) has followed suit. But Littleton and Morey consider $\mu\mu$ is good enough (P. 8).

In a private argument with Dr. Littleton, the reviewer has suggested that in a strictly scientific treatise the only satisfactory way is the petrographic or "Insley" way.

Dr. Littleton has replied that the only scientific way when one is talking about *"strain"* (which is not the case in crystal studies as performed by Insley on "stones" or Morey on devitrification crystal—"phases"), is to forget optical terms altogether and speak in terms of the actual *stress,* that is, in mechanical terms. In respectable circles this means, in lb/sq. in: but at Corning it probably means kilograms per square centimeter or millimeter, and at the Geophysical it might mean kilomegabaryes or some other extinct reptile.

However, the idea of talking about stress, when stress is the real thing at stake, is obviously very sensible and we hope some agreement can be reached on this point and on our terminology in general. But on any account, the pages of the Littleton-Morey books that deal with annealing have only added to the confusion.

The essence of the book, of course, is the electrical sections proper. Here a definite and valuable contribution has been made to the literature on glass. We hope that with such a start as this, a few years may see the subject clarified to a point where many of the obscurities pointed out by the authors can be reconciled in a systematic body of knowledge. At present there are obviously many loose ends. The publication of such a monograph as this shows how difficult it is going to be in the future to produce any complete work on glass technology.

We note with satisfaction and with relief, that in the foreword by J. B. Whitehead, glass is definitely characterized as a solid. We are wondering whether this represents a change of heart at the Geophysical, or whether they are all tearing their hair.

F. W. PRESTON.

THE AMERICAN CYANAMID & CHEMICAL CORPORATION has opened an office in the New Center Building, Detroit, Michigan. The telephone number of the office is Trinity 2-1330. Mr. George S. Horsfull, who is the resident representative of the Company, will be in charge of the new office.

Net earnings of the Libbey-Owens-Ford Glass Company during the third quarter were $1,526,934.92 compared with a loss of $487,037.45 for the corresponding quarter of last year. Earnings for the nine months ended September 30, 1933 were $3,684,018.41 whereas the corresponding period of 1932 showed a loss of $438,907.35.

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of The GLASS INDUSTRY, published monthly at New York, N. Y., for October 1, 1933, State of New York, County of New York,—ss. Before me, a Notary Public, in and for the State and County aforesaid, personally appeared H. Glass, who, having been duly sworn according to law, deposes and says that she is the business manager of The GLASS INDUSTRY, and that the following is to the best of her knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Glass Industry Publishing Co., Inc., 102 Maiden Lane, New York; editors, none; managing editor, G. W. Cooper, G. W. Cooper, 102 Maiden Lane, New York, R. D. Proctor, 102 Maiden Lane New York.

2. That the owners are (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock): Glass Industry Publishing Co., Inc., 102 Maiden Lane, New York, G. W. Cooper, 102 Maiden Lane, New York, R. D. Proctor, 102 Maiden Lane, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are (If there are none, so state): None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders, and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements, embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. G. W. Cooper, Managing Editor. Sworn to and subscribed before me this 25th day of September 1933. (Seal) Murray I. Burstein, Notary Public. (My commission expires March 1934.)

Current Prices of Glass-Making Materials

as of October 21, 1933.

Quotations furnished by various producers, manufacturers and dealers

Acid		Carlots	Less Carlots
Citric (dom.)	lb.	...	.29
Hydrochloric (HCl) 20° tanks	Per 100 lb.	...	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	...	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext.	Per 100 lb.	5.50	...
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	...
Tartaric	lb.	... Po. or Gr. / Cry.	.24 / .24½
Alcohol, denatured	gal.	...	...
Aluminum hydrate ($Al(OH)_3$)	lb.	.04-.04½	.05½-.06
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Ammonium bifluoride (NH_4FHF)	lb.	...	15¼
Ammonia water (NH_4OH) 26° drums	lb.	...	.02¾
Antimony, metallic (Sb)	lb.	.02½	.02¾
Antimony oxide (Sb_2O_3)	lb.	.08	.08½
Antimony sulphide (Sb_2S_3)	lb.	...	.08½
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.04	.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	56.50	...
90% through 100 mesh	ton	44.00	...
Barium hydrate ($Ba(OH)_2$)	lb.	...	.05¾
Barium mixture, glassmaker's, f. o. b. St. Louis	ton	25.00	...
Barium nitrate ($Ba(NO_3)_2$)	lb.	...	.08¼
Barium selenite ($BaSeO_3$)	lb.	...	...
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Bone ash, carlots	lb.	.06	.06½
Borax ($Na_2B_4O_7·10H_2O$)	lb.	...	...
Granulated	In bags, lb.	.02	.02¼-.02½
Powdered	In bags, lb.	.02¼	.02½-.02¾
Boric acid (H_3BO_3)	In bags, lb.	.04¼	.04½-.04¾
Cadmium sulphide (CdS)— Red	lb.	...	.60-.75
Orange	lb.	...	.55-.65
Yellow	lb.	...	1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	...	.18¾
Cobalt oxide (Co_2O_3) In bbls	lb	...	1.15
In 10 lb. tins	lb.	...	1.25
Copper oxide Red (Cu_2O)	lb.	...	.25
Black (CuO)	lb.	...	.17-.19
Black prepared	lb.	...	.22
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.08½	.09
Synthetic (Artificial)	lb.	...	.08
Epsom salts ($MgSO_4$) (imported) technical	Per 100 lb.	...	2.40
Feldspar— 40 mesh	ton	10.00-11.50	
20 mesh	ton	10.00-11.50	
Granular	ton	10.00-12.50	
Semi-granular	ton	10.00-11.50	
L. C. L., (Min. 2 tons) $2.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%) Bulk, carloads, f. o. b. mines	ton	30.00	...
In bags or barrels	ton	34.00	39.00
Imported	ton		
Formaldehyde	lb.	...	.07
Graphite (C)	lb.	...	.04-.07
Iron oxide— Red (Fe_2O_3)	lb.	...	.0425
Black (FeO)	lb.	.04½	...
Kaolin (f. o. b. mine)	ton	8.00-9.00	...
English, lump, f. o. b. New York	ton	14.50-25.00	24.50-30.00

Kryolith (see Cryolite)		Carlots	Less Carlots
Lead chromate ($PbCrO_4$)	lb.	...	.30
Lead oxide (Pb_3O_4) (red lead)	lb.	.065	.075
Litharge (PbO)	lb.	.055	.065
Lime— Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	9.00	...
Burnt (CaO) ground, in bulk	ton	6.50	...
Burnt, ground, in paper sacks	ton	8.50	...
Burnt, ground, in 280 lb. bbls	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		1.50-2.50	...
Magnesia (MgO)— Calcined, heavy (in bbls)	lb.	.06	.07
light (in bbls)	lb.	...	.23
extra light (in bbls.)	lb.	...	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.10
Manganese 85% (MnO_2)	lb.	57.50	62.50
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	...	.35
Nickel monoxide (NiO), green— for nickel content	lb.	...	.35
Plaster of Paris, bags	ton	31.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)— Crystals	lb.	.07½	.08
Powdered	lb.	.08	.08½
Potassium carbonate—94-96%	lb.	.0787½	.0825
Calcined (K_2CO_3) 96-98%	lb.		
Hydrated 80-85%	lb.	.07¼	.0775
Potassium chromate (K_2CrO_4)	lb.	...	.14¼
Potassium hydrate (KOH) (caustic potash)	lb.	.07½	.09
Potassium nitrate (KNO_3) (gran.)	lb.	...	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.17½	.18
Powdered blue	lb.	...	.23
Rochelle salts, bbls	lb.	...	.12½
Rouge	lb.	... Po. or Gr. / Cry.	.13½
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	18.00	...
Selenium (Se)	lb.	...	1.70
Silver nitrate (AgNO)	(100 oz.) per oz.	...	.28
Soda ash (Na_2CO_3) dense, 58%— Bulk	Flat Per 100 lb.	1.05	...
In barrels	Per 100 lb.	1.38	...
In bags	Per 100 lb.	1.17½	...
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.05½	.06
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.50	...
Sodium nitrate ($NaNO_3$)— Refined (gran.) in bbls	lb.	...	3.62
95 per cent	Per 100 lb.	1.195-1.295	1.245-1.345
Sodium selenite (Na_2SeO_3)	lb.	...	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04½	.05-.06
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	...	1.40-1.45
Sulphur (S)— Flowers, in bbls	Per 100 lb.	3.45	3.70-4.05
Flowers, in bags	Per 100 lb.	3.10	3.35-3.65
Flour, heavy, in bbls	Per 100 lb.	2.85	3.20-3.45
Tin chloride ($SnCl_2$) (crystals)	lb.	.35	35½
Tin oxide (SnO_2) in bbls	lb.	...	.50
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	...	2.75
Yellow orange	lb.	...	1.40
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.05¾	.06
Zircon Granular (Milled .005-.02c higher)		.07	.67½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Increase in Orders for General Electric

Orders received by the General Electric Company for the third quarter of 1933 amounted to $43,733,499, compared with $35,539,858 for the second quarter of this year and with $25,665,402 for the third quarter of 1932, an increase over last year of 70 per cent., President Gerard Swope announced.

For the nine months ended September 30, orders received this year amounted to $104,785,001, compared with $94,374,114 for the first nine months of 1932, an increase of 11 per cent.

H. H. Dewey

Herbert H. Dewey, vice-president of the International General Electric Company, Inc., died at his home in Schenectady October 25, after a short illness.

September Production of Plate Glass

The total production of polished plate glass by the member companies at the Plate Glass Manufacturers of America, as reported by Secretary P. A. Hughes, for the month of August 1933 was 8,924,666 sq. ft. making a total of 31,601,677 sq. ft. for the third quarter of 1933, and a total of 69,728,025 sq. ft. for the first nine months of 1933.

On November 9, Dr. Alexander Silverman, Head of the Department of Chemistry, University of Pittsburgh, will give an illustrated lecture on "Glass: Today and Tomorrow," in which he will discuss methods at present employed in the manufacture of glass and in the control of its properties. Professor Silverman will discuss further problems which arise in connection with new developments and with future types for which research men are already preparing.

Tank Blocks Clay Pots

Product of

Pittsburgh Plate Glass Company
Refractories Department

Grant Building,
Fourth Avenue and Grant Street
PITTSBURGH, PA.

GAS PRODUCERS
Reversing Valves
Dust Catchers
and Flues
WELLMAN WELLMAN
THE WELLMAN ENGINEERING CO.
CLEVELAND, OHIO

The Glass Industry Classified Buyers' Guide

FOR FURTHER INFORMATION, SEE ALPHABETICAL DIRECTORY OF ADVERTISERS AND CONSULT ADVERTISEMENTS

ALUMINUM HYDRATE
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

ALUMINUM OXIDE
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

ALUMINUM SULPHATE
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

ANTIMONY OXIDE
Drakenfeld, B. F., & Co., Inc., New York.

ARSENIC
Drakenfeld, B. F., & Co., Inc., New York.

AUTOMATIC BOTTLE MACHINERY (See Glass Working Machinery)

AUTOMATIC CONVEYORS AND LEHR LOADERS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.

AUTOMATIC GLASS WORKING MACHINERY (See Glass Working Machinery)

AUTOMATIC TEMPERATURE CONTROL
Wilson-Maeulen Pyrometer Division, The Foxboro Co., Foxboro, Mass.

BATCH CARTS
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

BATCH HANDLING AND MIXING SYSTEMS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

BLOWERS AND EXHAUSTERS
The Kirk & Blum Mfg. Co., Cincinnati, O.

BLOWER SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

BOND CLAY
Amsler-Morton Company, The, Pittsburgh, Pa.
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Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

BORAX
American Potash & Chemical Corp., New York.
Pacific Coast Borax Co., New York.

BORIC ACID
American Potash & Chemical Corp., New York.
Pacific Coast Borax Co., New York.

BOTTLE-MAKING MACHINERY (See Glass Working Machinery)

BRICK INSULATING
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

CADMIUM SULPHIDES
Drakenfeld, B. F., & Co., Inc., New York.

CASTINGS, GLASSHOUSE
Dixon, H. L., Co., Pittsburgh, Pa.

CEMENT, HIGH TEMPERATURE
Laclede-Christy Clay Products Co., St. Louis, Mo.

CHEMICALS, COLORS, MINERALS, ETC. GLASSMAKERS
American Potash & Chemical Corp., New York.
Drakenfeld, B. F., & Co., Inc., New York.
Pacific Coast Borax Co., New York.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Sharp-Schurtz Company, Lancaster, O.
Solvay Sales Corporation, Syracuse, N. Y.

CHEMISTS, CONSULTING
Bailey & Sharp Co., Inc., Hamburg, N. Y.
Preston, F. W., Natl. Bank Bldg., Butler, Pa.
Sharp-Schurtz Company, Lancaster, O.
Solvay Process Co., Syracuse, N. Y.

CHIMNEYS, FACTORY
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

CHROME OXIDE
Drakenfeld, B. F., & Co., Inc., New York.

CLAY For Glassmakers
(See also Bond, Clay, Fire and Furnace Clay)
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

CLAY POTS
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

COAL HANDLING AND STORAGE SYSTEMS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

COBALT OXIDE
Drakenfeld, B. F., & Co., Inc., New York.

CONSULTANTS, GLASS CHEMISTS
Bailey & Sharp Co., Hamburg, N. Y.
Preston, F. W., Butler, Pa.
Sharp-Schurtz Company, Lancaster, O.

CONTRACTORS
Furnace Construction and Repairs
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Toledo Engineering Co., Inc., Toledo, O.

COOLING SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

COPPER OXIDE, BLACK
Drakenfeld, B. F., & Co., Inc., New York.

CRUSHERS & PULVERIZERS
(Cullet, Coal, etc.)
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

CRYOLITE
Natural Greenland
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

DAMPER, SAND
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

DECOLORIZERS
Drakenfeld, B. F., & Co., Inc., New York.
Sharp-Schurtz Company, Lancaster, O.

DECORATING MATERIALS AND COLORS
Drakenfeld, B. F., & Co., Inc., New York.

ELBOWS AND FITTINGS, SHEET METAL
The Kirk & Blum Mfg. Co., Cincinnati, O.

ENGINEERING SERVICE
Factory Buildings

Chimney and Power Plant
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Fuel and Furnace
Amsler-Morton Company, The, Pittsburgh, Pa.
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.
Sharp-Schurtz Company, Lancaster, O.
Toledo Engineering Co., Inc., Toledo, O.

Glass Factory
Amsler-Morton Company, The, Pittsburgh, Pa.
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Sharp-Schurtz Company, Lancaster, O.
Toledo Engineering Co., Inc., Toledo, O.

Mechanical
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Plate Glass Factory
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Producer Gas
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wellman Engineering Co., Cleveland, O.

FANS, EXHAUST
The Kirk & Blum Mfg. Co., Cincinnati, O.

FEEDERS, AUTOMATIC GLASS (See Glass Feeders)

FELDSPAR
Sharp-Schurtz Company, Lancaster, O.

FIRE BRICK (See also Refractories)
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.

FIRE AND FURNACE CLAY
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

FLOATING AGITATORS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

FOUNDERS, GLASSHOUSE CASTINGS
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

FURNACE ENGINEERS (See Engineering Service)

FURNACE INSULATION (See Insulating Brick)

FURNACE REPAIR MATERIALS
Amsler-Morton Company, The, Pittsburgh, Pa.
Corhart Refractories Co., Louisville, Ky.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

FURNACES

Annealing (See Lehrs)

Tank and Pot
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Recuperative
Amsler-Morton Company, The, Pittsburgh, Pa.
Toledo Engineering Co., Inc., Toledo, O.

GAS BURNERS
Amsler-Morton Company, The, Pittsburgh, Pa.
Bailey & Sharp Co., Hamburg, N. Y.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Sharp-Schurtz Company, Lancaster, O.
Toledo Engineering Co., Inc., Toledo, O.

GAS MAINS, STEEL
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

GAS PRODUCERS (See Producer Gas Plants)

GLASS CONSULTANTS
Bailey & Sharp Co., Hamburg, N. Y.
Sharp-Schurtz Company, Lancaster, O.

GLASS FEEDERS, AUTOMATIC
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.
Miller, Wm. J., Inc., Swissvale, Pa.

GLASSHOUSE CASTINGS (See Castings)

GLASSHOUSE MACHINERY AND EQUIPMENT (See also Glass Working Machinery)
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.
Miller, Wm. J., Inc., Swissvale, Pa.

GLASSHOUSE TOOLS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

GLASS PLANTS, COMPLETE INSTALLATION
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.

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Automatic and Semi-Automatic Bottle Blowing, Electric Presses, Feeders, etc.
Bailey & Sharp Co., Hamburg, N. Y.
Hartford-Empire Co., Hartford, Conn.
Wm. J. Miller, Inc., Swissvale, Pa.

GLORY HOLES, PORTABLE
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

HEATING SYSTEMS, HOT BLAST
The Kirk & Blum Mfg. Co., Cincinnati, O.

INSULATING BRICK, FURNACE AND BOILER
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

INSULATION, HEAT
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

KETTLES (all kinds)
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

LEHR LOADERS (See Automatic Conveyors and Lehr Loaders)

LEHRS
Electric
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Hartford-Empire Co., Hartford, Conn.

"Fireless", Automatic
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

Muffle
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Toledo Engineering Co., Inc., Toledo, O.

LEPIDOLITE
Drakenfeld, B. F., & Co., Inc., New York.

MACHINE SHOP SERVICE
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

MANGANESE
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MIXERS, BATCH (See Batch Handling Systems)

MOLDS, MACHINE AND HAND
Miller, Wm. J., Inc., Swissvale, Pa.
Toledo Mould Co., Factories Bldg., Toledo, O.

OPACIFIERS
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

POWDERED BLUE
Drakenfeld, B. F., & Co., Inc., New York.
Sharp-Schurtz Company, Lancaster, O.

POT CLAY
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

PRODUCER GAS PLANTS
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wellman Engineering Co., Cleveland, O.

PYROMETERS, RECORDING and INDICATING
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wilson-Maeulen Pyrometer Division, The Foxboro Co., Foxboro, Mass.

PYROMETER TUBES
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Wilson-Maeulen Pyrometer Division, The Foxboro Co., Foxboro, Mass.

REFRACTORIES (See also Fire Brick)
Glass House
Amsler-Morton Company, The, Pittsburgh, Pa.
Corhart Refractories Co., Louisville, Ky.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

REVERSING VALVES, GAS AND AIR
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

SALT CAKE
Drakenfeld, B. F., & Co., Inc., New York.
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.

SELENIUM
Drakenfeld, B. F., & Co., Inc., New York.

SHEET METAL WORK
The Kirk & Blum Mfg. Co., Cincinnati, O.

SODA ASH
Solvay Sales Corporation, Syracuse, N. Y.

SODIUM SELENITE
Drakenfeld, B. F., & Co., Inc., New York.

STORAGE BINS, RAW MATERIALS (See also Coal Handling and Storage Systems, and Batch Handling and Mixing Systems)
Amsler-Morton Company, The, Pittsburgh, Pa.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.

TANK BLOCKS
Amsler-Morton Company, The, Pittsburgh, Pa.
Corhart Refractories Co., Louisville, Ky.
Dixon, H. L., Co., Box 140, Pittsburgh, Pa.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Pittsburgh Plate Glass Co., Refractories Dept., Pittsburgh, Pa.

TANK FURNACES (See Furnaces)

URANIUM OXIDE
Drakenfeld, B. F., & Co., Inc., New York.

VENTILATING SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

WASTE HEAT RECLAIMING SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

WIND AND VENTILATING SYSTEMS
The Kirk & Blum Mfg. Co., Cincinnati, O.

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Directory of Advertisers

American Cyanamid & Chemical Corp. 3
American Potash & Chemical Corp. 4
Amsler-Morton Company 5

Bailey & Sharp Co., Inc. 9

Corhart Refractories Co. 2

Dixon, H. L., Company 4
Drakenfeld, B. F., & Co. 5

Foxboro Co., The Wilson-Maeulen Pyrometer Division 1

Hartford-Empire Co. 6

Laclede-Christy Clay Products Co. 5

Pacific Coast Borax Co. 9
Pittsburgh Plate Glass Co., Refractories Department 7
Preston, F. W. 9

Sharp-Schurtz Co. 9
Solvay Sales Corporation 9

Wellman Engineering Co. 7
Wilson-Maeulen Pyrometer Division, The Foxboro Company 1